

**A POST OPERATIVE EVALUATION
OF CASES OF LENS INDUCED GLAUCOMA**

THESIS
FOR
MASTER OF SURGERY
(OPHTHALMOLOGY)



BUNDELKHAND UNIVERSITY
JHANSI

DEDICATED TO

MY MOTHER

But for whom I would not have
reached so far.

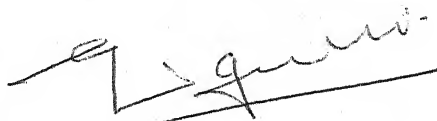
DEPARTMENT OF OPHTHALMOLOGY, MAHARANI LAXMI BAI
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C E R T I F I C A T E

This is to certify that the work entitled
"A POST OPERATIVE EVALUATION OF CASES OF LENS
INDUCED GLAUCOMA", which is being submitted as a thesis
for M.S. (Ophthalmology) examination, 1998 of Bundel-
khand University, Jhansi by DR. RIMKI PAL, has been
carried out in the department of Ophthalmology, M.L.B.
Medical College, Jhansi.

She has put in the necessary stay in the department
for submission of thesis, as required by regulations of
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The techniques embodied were undertaken by the candidate
herself and observations were checked and verified by me
from time to time.

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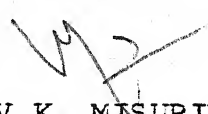
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INTRODUCTION

INTRODUCTION

Glaucoma is one of the leading causes of blindness and is responsible for 3-5 percent of all blindness in India. Glaucoma may be primary or secondary to some ocular or non-ocular disorders which alter the aqueous outflow, resulting in elevation of intraocular pressure. Thus glaucoma refers to a variety of disorders which differ in their clinical presentation, patho-physiology and modes of treatment.

One of the types of secondary glaucoma is lens induced glaucoma. In India, a large cataract backlog of 12 million¹ exists and it is increasing annually at an estimated rate of 3.8 million². So it is not surprising that the occurrence of lens induced glaucoma is not an infrequent event.^{3,4}

The problem of lens induced glaucoma is a rather common entity in rural India owing to the delay in getting the cataract removed because of the general belief that cataract surgery is neither indicated nor feasible unless the cataract becomes 'ripe'. Also in the European races, there is a gradual shrinkage of lens with the development of cataract and hence a progressive deepening of the anterior chamber results.⁵ Therefore, phacomorphic glaucoma is

unusual in those people. While in Indians, the opposite occurs and cataract seems to become intumescent more commonly.

There are a variety of lens induced glaucomas.⁶

1. Phacomorphic glaucoma : A swollen lens causes increased pupillary block and secondary angle closure.
2. Phacolytic glaucoma : Lens protein leaks from an intact cataract and obstructs the trabecular meshwork.
3. Dislocated Lens : A dislocated lens causes increased pupillary block and secondary angle closure.
4. Lens particle glaucoma : Lens material liberated by trauma or surgery obstructs the outflow channels. It is also known as phacotoxic glaucoma.
5. Phacoanaphylaxis : Sensitization to lens protein produces glaucomatous inflammation and occasionally secondary glaucoma.

Of these, phacomorphic and phacolytic being the most commonly encountered types; in the present study

only phacomorphic and phacolytic cases of secondary glaucoma has been included with special attention to the prognostic indicators for a good postoperative visual acuity.

Many controversies exist regarding the mode of treatment for lens induced glaucoma. This clinical entity has traditionally been associated with a poor visual outcome. In fact some studies while reviewing visual outcome after cataract extraction have attributed a poor outcome to the existence of lens induced glaucoma pre-operatively.⁷

Historically, intracapsular cataract extraction^{6,8,9,32-35} has been the treatment of choice for these conditions. Now there has been a distinct shift towards extracapsular cataract extraction with 'in-the-bag'¹⁰⁻¹² lens implantation. Controversy however exists regarding the usefulness of adding antiglaucoma procedures alongwith cataract extraction. While some authors claim that combined procedures are essential to obtain normal intraocular tension post-operatively, others claim that cataract extraction alone is curative.

In this study, the incidence of lens induced glaucoma has been calculated. These patients were treated by intracapsular cataract extraction alone or

by extracapsular cataract extraction alone or by intra or extracapsular cataract extraction alongwith trabecul-ectomy. All those patients with peripheral anterior synechiae extending for more than 180 degrees of the circumference of angle of anterior chamber were treated by the combined procedure. Their respective post-operative intraocular pressures and best corrected visual acuity at 6 weeks follow up was recorded.

In India, with a vast rural population, many community based programmes for cataract extraction exist. In such settings, the main mode of surgery being used is as yet intracapsular cataract extraction. In tertiary centres however the trend has shifted towards extracapsular cataract extraction with intraocular lens implantation.⁵² Through this study, we have tried to evaluate whether good visual results can be obtained in lens induced glaucoma, postoperatively, and if the modality of surgery performed has any bearing on the visual outcome.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Parker Heath in 1940¹³ classified secondary glaucoma due to the lens to be due to :

- i) Lens in position,
- ii) Lens out of position.

Glaucoma with the lens in position can be due to -

- imperfect differentiation of angle.
- intumescent lens associated with irritative contact with the ciliary processes.
- toxic substances escaping through the permeable capsule of a hypermature cataract.
- desquamation of capsule.
- following uveitis which causes posterior synechiae and iris bombe formation.
- perforating wounds to the lens.
- endophthalmitis phacoanphylactica.¹⁴

Glaucoma with the lens out of position can be due to -

- congenital lentical ectopia.
- subluxation of lens making it come into contact with ciliary processes.
- subluxation into anterior chamber causing pupillary block.

- subluxation onto cornea - phacocoele due to corneal perforation.
- subluxation into anterior, posterior or central vitreous.
- subluxation onto retina or optic nerve head.

Good visual recovery followed removal of lens along with its capsule by Verhoeff's method with complete iridectomy.

Flocks Milton et al in 1955 conducted a clinico-pathologic study of one hundred and thirty eight cases of glaucoma associated with hypermature cataract. They noted that liquefaction of the lens cortex and degeneration of the lens capsule and epithelium permit escape of the lens liquid into the anterior chamber. Capsular rupture was not an essential factor for its occurrence. The lysed cortical material evokes a histiocytic response and consequent plugging of trabecular spaces by macrophages.¹⁶ Hence after delivery of the lens, the anterior chamber should be irrigated to remove as much Morgagnian fluid and macrophages as possible. On biopsy, the retina, disc and optic nerve were characteristically well preserved and hence they concluded that good visual results would be obtained by removal of hypermature lens and irrigation of the anterior chamber.

Smith ME and Zimmerman LE (1965)¹⁷ reviewed 125 cases of phacolytic glaucoma from the files of the Registry of Ophthalmic Pathology. The sections of the eyes from all these cases were examined with particular reference to configuration of chamber angle. The objective was to determine the frequency of angle recession occurring as a result of trauma.¹⁸⁻²⁰ They found that nearly 25% of cases had unequivocal evidence of trauma while another 18% had equivocal evidence of contussive damage. A definite history of trauma was found in 50% of the cases showing unequivocal changes of trauma, while 44% of cases with equivocal changes had a history of trauma. Heretofore, phacolytic glaucoma has been thought to occur almost exclusively as a complication of senile hypermature cataracts unassociated with other intraocular disease. The present study shows that in nearly 25% of cases, there is a definite evidence of angle recession characteristic of lod contusion. Trauma may play a significant pathogenetic role in phacolytic glaucoma in several ways. While prompt cataract extraction may be curative in many cases of phacolytic glaucoma unsatisfactory results may be obtained if there has been considerable subclinical damage to retina and optic nerve prior to the onset of phacolytic glaucoma.

Epstein David L et al in 1977²¹ identified high molecular weight soluble proteins in the aqueous humor from patients of phacolytic glaucoma.

Aqueous humor was obtained by paracentesis at the time of cataract surgery from six patients with phacolytic glaucoma diagnosed on the basis of acute unilateral open angle glaucoma associated with an apparently leaking hyper-mature or mature cataract and from six control patients with immature cataracts. Three of the latter had primary open angle glaucoma. Quantities of high molecular weight protein^{22,23} (molecular weight more than 150×10^6), sufficient to obstruct aqueous outflow were identified in all six phacolytic aqueous humor specimens but in none of the controls. Three of the hypermature cataractous lenses from the cases of phacolytic glaucoma were also examined and were found to have fourteen fold greater quantities of high molecular weight proteins in their liquefying cortex than were present in the cortex of immature cataractous lenses. These findings correlated with high molecular weight protein perfusion studies²⁴ suggested direct obstruction of aqueous outflow channels by liberated high molecular weight soluble lens protein and thus causing phacolytic glaucoma.

Epstein David L in 1982²⁵ in a review titled 'Diagnosis and Management of Lens Induced Glaucoma' said that lens

induced glaucoma may occur either as secondary angle closure or open angle glaucoma. Dislocation or swelling of the lens can cause pupillary block⁴⁶ and subsequent angle closure glaucoma. Leakage of soluble lens particles from a relatively intact cataractous lens^{6,27} can result in a severe secondary open angle glaucoma (phacolytic glaucoma). Heavy molecular weight protein believed to be of lens origin,^{21,24} was identified in twelve out of twelve anterior chamber specimens from such patients. This liberated lens protein can directly obstruct the trabecular outflow pathways. After extracapsular cataract extraction or lens trauma, liberated fragments of lens material may mechanically impair the drainage of aqueous humor through the outflow channels^{6,24,27} (lens particle glaucoma). The diagnosis and management of these different lens induced glaucoma were reviewed and surgical removal of the lens and lens material^{15,28,29} suggested as treatment for good visual rehabilitation. Lens dislocation causing angle closure glaucoma should be treated by peripheral iridectomy especially laser iridotomy³⁰ or by iridectomy.

Jain IS et al in 1983⁴ studied eighty six cases of phacomorphic glaucoma - its management and visual outcome. They recorded incidence of phacomorphic glaucoma to be 3.91%. In all eighty six cases, intraocular pressure could be controlled preoperatively with or without mannitol. Intracapsular cataract extraction was done in 57% (49 eyes) planned extracapsular cataract extraction in 9 eyes and

combined extraction with trabeculectomy in nine eyes. 19 eyes (20.2%) had accidental rupture of the lens capsule.

93% of the cases had normal intraocular pressure at the end of the followup period without any medication and irrespective of the duration of attack and type of surgery. Final visual outcome was directly related to the duration of attack. 54.5% of the eyes with less than two days of attack regained 6/12 or better visual acuity, whereas if the attack lasted 3 weeks or more, visual acuity was no better than hand movements or perception of light.

Optic disc changes in the form of pallor, glaucomatous cupping and atrophic cupping were directly related to the duration of attack of the 59 eyes in which duration of glaucoma was less than 10 days, 45 eyes (76.2%) had clinically normal optic discs.³¹

Though bilateral phacomorphic glaucoma was encountered in nearly 14% of the eye cases, they do not recommend prophylactic iridectomy on the fellow eyes as -

- a) the occurrence of phacomorphic attack seemed to occur almost 10 years later.

- b) the surgical procedure itself may accelerate the formation of a hydrated cataract.
- c) observations of acute phacomorphic glaucoma in 3 eyes where an iris inclusion had already been done.

10

Lane Stephen S et al in 1988 studied the efficacy of extracapsular cataract extraction as a definitive treatment for phacolytic glaucoma. Five cases of phacolytic glaucoma that occurred between 1984 & 1986 were studied from a retrospective chart review. Extracapsular cataract extraction with placement of a posterior chamber intraocular lens was performed and was curative in all five eyes. All patients (100%) maintained intraocular pressures of less than 20 mm of mercury without medical therapy. The best corrected visual acuity for all cases was 20/50 or better (80% had more than 6/12) with 5 months to 5 years follow up. They concluded that extracapsular cataract extraction with posterior chamber intraocular lens placement is a safe and efficacious³⁶ treatment for phacolytic glaucoma. According to them the phacolytic lens capsule was not more fragile. Although they preferred extracapsular cataract extraction with posterior chamber intraocular lens as treatment of choice for phacolytic glaucoma, they also said that the surgeon should employ the technique with which he was more familiar that is intra-

capsular cataract extraction or extracapsular cataract extraction.

37

Angra SK et al in 1991 described an insight into management of cataract induced glaucoma. They studied 40 cases of phacomorphic glaucoma and evaluated the efficacy of medical therapy, intraoperative and post-operative complications, and the effect of high intraocular pressure and surgical trauma on the corneal endothelium.

They found that 55% of the patients were in the group 50 to 60 years. The incidence of phacomorphic glaucoma was 3.91%. 23 of the patients had immature intumescent cataracts, while 17 had hypermature swollen cataracts. Pre-operative intraocular pressure ranged between 34 to 83 mmHg. Medical therapy given was with topical pilocarpine, oral glycerol, diamox and intravenous mannitol. They found no relationship with duration of attack and height of intraocular pressure. In 37.5% of eyes intraocular pressure could not be controlled with medical therapy. These eyes were found to have extensive peripheral anterior synechiae and longer duration of attack. Inaccurate light projection could be corrected in 9 out of 16 patients with medical treatment alone. Endothelial cell loss was found to be 14.8% after the attack.

38

Cases were randomly subjected to intracapsular cataract extraction alone or ICCE with trabeculectomy. Striate keratopathy and shallow anterior chamber was more post-operatively in the ICCE group. Control of intraocular pressure post-operative was better in the combined extraction group. Only in 75% of patients could intraocular tension be normalised post-operatively. In those with longer duration of attack, cataract extraction alone does not seem to control tension. Better overall visual recovery was achieved in the combined extraction group. Initial faulty light projection does not necessarily mean a poor visual outcome. Final visual acuity was related more to duration of attack than to type of cataract or modality of surgery.

39

Tomey KF and Rajhi AA in 1992 reviewed 10 patients of phacomorphic glaucoma who underwent Nd : YAG laser iridotomy for the initial management of acute angle closure glaucoma. In all the cases the acute angle closure glaucoma could be reversed by iridectomy before cataract extraction.

They felt that the initial angle closure was caused by pupillary block ⁴⁰⁻⁴² and responds well to the same type of treatment as primary angle closure glaucoma namely

iridotomy. According to them laser iridotomy benefits phacomorphic glaucoma cases in three ways -

1. After iridotomy, the eye is allowed to quiet down from an acute attack and thus be in a better condition for cataract surgery.
2. Pre-operative mydriasis becomes safer.
3. It becomes possible for the surgeon to decide whether glaucoma surgery should be performed simultaneously with cataract extraction.

Lin TH et al (1993)⁷ carried out a retrospective study of 995 eyes that underwent cataract surgery between January and March, 1990. The study revealed that one in 20 (50 eyes) were of advanced cataracts (Hypernature, Morgagnian and Intumescent). Thirty percent of these cases suffered from cataract related complications pre-operatively : phacomorphic glaucoma (12/50 eyes) phacolytic glaucoma (1/50 eyes) and subluxated cataract without trauma (2/50 eyes). Cataract surgery in these advanced cataracts produced significantly poorer results than the rest. One in four eyes failed to achieve a visual acuity of 6/12 or better post-operatively, while one in eight eyes did not improve beyond hand movement vision. They concluded that the main reason for poor visual results was lens induced glaucoma 80%.

11

Singh G et al in 1994 evaluated the results of conventional extracapsular cataract extraction with posterior chamber intraocular lens in a series of five cases of phacolytic glaucoma.

Five cases between age of 64 and 70 years were taken. Only those cases with minimal lenticular changes and good visual status in the fellow eye were included in the study to avoid problems of unilateral aphakia. The period between diagnosis and surgery varied between 3-6 days depending on the control of uveitis and glaucoma. All the cases were operated by the same surgeon, after control of uveal inflammation and intraocular pressure by appropriate medical therapy.

In this study, with a mean follow up period of 2 years all patients maintained a normal post-operative intraocular tension of less than 20 mmHg without any additional medical therapy. The best corrected visual acuity in 80% of cases (4 out of 5) was 6/12 or better. Vision was 6/24 in one case due to senile maculopathy. Hence they concluded that planned extracapsular cataract extraction with posterior chamber intraocular lens implantation is a safe and effective method of visual rehabilitation in cases of phacolytic glaucoma.

10,33,34

Mandal AK in 1994 described endocapsular surgery and capsular bag fixation of intraocular lens^{12,43-49} in nineteen cases of phacolytic glaucoma. Anterior capsulotomy is the key step in endocapsular cataract surgery. This is easier in immature cataracts but requires great care in eyes with phacolytic glaucoma with hypermature morgagrian cataracts, where the capsule is fragile, zonules are weak and view obscured by milky white fluid cortex leaking from the taut capsular bag into anterior chamber. To overcome these difficulties, he recommended aspiration of milky fluid cortex from the capsular bag before capsulotomy so that a minimal amount of irrigating solution is required for cortical clean up. This he called the "dry technique" of extracapsular cataract extraction in morgagrian cataract. He also recommended a V-shaped anterior capsulectomy^{47,48,49} with angled Vannas Scissors to avoid zonular dialysis.^{50,51} Before the nucleans is delivered, methyl cellulose is injected between the nucleans and posterior capsule to severe adhesions that are sometimes present between the nucleans and the posterior capsule.

Posterior chamber intraocular lens were implanted in 8 eyes out of 19 eyes. Extracapsular cataract extraction was done in 11 eyes. 16 eyes (84.2%) achieved visual acuity 76/12 of which 8 were those with intraocular lens

and 8 with extracapsular cataract extraction alone. Relatively poor visual acuity in remaining 3 eyes were due to delayed presentation causing glaucomatous damage to the optic nerve. Post operative intraocular pressure of less than 20 mmHg was achieved in all eyes without antiglaucoma medication.

⁵³
Barnhorst D et al in 1996 reported an unusual case of lens induced glaucoma that occurred 65 years after congenital cataract extraction. It was a case of lens particle glaucoma caused by pieces of lens material, which are loosened when the lens capsule is disrupted by trauma or during an operation. However, increased intraocular pressure in these cases usually occurs a few days after the trauma or operation and rarely years later. The patient underwent a pars plana vitrectomy to remove the residual brown yellow cortical lens material. Six months later best corrected visual acuity was 6/12 tension by applanation tonometry was 21 mmHg and the anterior chamber and vitreous cavity had no cells or flare.

In this patient the moderately large amount of residual lens material probably increased the risk of lens induced glaucoma. Perhaps it took many years for the lens material to denature to a high molecular weight²¹ protein and subsequently break into small pieces and

release soluble lens protein resulting in lens particle and phacolytic glaucoma.

57

Pranja NV et al 1996 studied the clinical models of presentation and post-operative usual results in 93 patients with lens induced glaucoma of which 59 were of phacomorphic glaucoma and 44 were of phacolytic glaucoma. All the patients were subjected to planned extracapsular cataract extraction. 44% had a posterior chamber intraocular lens implantation following surgery. 57% eyes with phacomorphic glaucoma and 61% with phacolytic glaucoma recovered visual acuity of 6/12 or better. They found that there was no significant difference in the visual acuity between those patients who had an intraocular lens implantation and those who didnot ($p=0.18$). They found a slight female preponderance (54%) of lens induced glaucoma. The fellow eye in the case of patients with phacomorphic glaucomas had immature cataract in 80% patients, while in the case of phacolytic glaucoma, they were predominantly aphakic (72%). The mean intraocular pressure in the case of phacomorphic glaucoma was marginally higher 45 ± 12 mmHg than in phacolytic, in whom it was 40 ± 11 mmHg. The risk factors determining the final visual acuity were also studied by them. They concluded that age more than 60

^{22,55}
years and patients in whom the glaucoma was present for more than 5 days had a significantly higher risk of poor visual outcome post-operatively.

Mandal AK in 1997³⁸ in a review titled "An Alternative way to Manage patients with Morgagnian Cataracts and Phacolytic glaucoma" claimed that a simple technique of endocapsular surgery and capsular bag fixation of intraocular lens was a safe and effective way of treating patients of phacolytic glaucoma.¹²

He studied 37 cases of phacolytic glaucoma over a period of five years. A visual acuity of 6/12 or more was achieved in 66.7% of those who underwent extracapsular cataract extraction and 84.6% in those with extracapsular cataract extraction with posterior chamber intraocular lens implantation. Intraocular pressure was well controlled without antiglaucoma medication in all patients. Poor visual recovery was attributable to glaucomatous disc damage. The duration and elevation of intraocular pressure did not cause any clinically detectable damage in the out-flow pathway even when associated with significant glaucomatous disc damage.

Hence he concluded that addition of trabeculectomy to cataract extraction is superfluous in the control of intraocular pressure in patients with phacolytic glaucoma operated within 2 to 3 weeks of onset of symptoms.⁴

AIMS OF STUDY

AIMS OF STUDY

The present study is designed to find out the proportion of cases of lens induced glaucoma who attain a good postoperative visual acuity i.e. more than or equal to 6/12 and if there are any specific factors to determine the final visual outcome in these patients.

MATERIAL AND METHODS

MATERIAL & METHODS

All cases of lens induced glaucoma, who attended the Eye O.P.D. during a period of one year were analysed, after taking a detailed history and conducting a complete ocular examination under bright light and loupe. History of gradual diminution of vision which preceded the onset of pain redness and the duration of such an attack was elicited.

Detailed ocular examination included slit lamp examination to see the status of cornea, contents and depth of anterior chamber, condition of iris and lens. Gonioscopic examination of angle of anterior chamber of both eyes was done and the intraocular tension measured by Schiotz tonometer. Only cases of phacomorphic and phacolytic glaucoma were included in the study.

Phacomorphic glaucoma was recognized by the subjective complaints of pain and redness associated with the presence of corneal edema, shallow anterior chamber, an intumescent cataractous lens and intraocular pressure above 21 mmHg. Pre-operative measures to decrease intraocular pressure included topical application of timolol maleate 0.5% twice daily supplemented with oral acetazolamide 250 mg four times a day. 200 ml of 20% mannitol was given intravenously just before surgery.

Phacolytic glaucoma was diagnosed by the presence of pain, corneal edema, a normal or deep anterior chamber containing floating lens particles and the presence of a white hypermature morgagnian cataractous lens. The attempt to control intraocular pressure in these cases was made by the topical application of betamethasone 0.1% eye drops six time a day, timolol 0.5% twice a day and atropine 1% eye ointment once, supplemented with oral acetazolamide 250 mg four times a day. On the day of surgery 20% mannitol was given intravenously. Intraocular tension was recorded before and after giving medical treatment.

After obtaining informed consent and explanation of a relatively guarded prognosis, the patients irrespective of the diagnosis of either phacomorphic or phacolytic glaucoma, were subjected to either -

- Intracapsular cataract extraction, or
- ICCE with trabeculectomy, or
- Extracapsular cataract extraction, or
- ECCE with trabeculectomy.

Those patients in whom the attack had lasted long enough to form peripheral anterior synechiae obstruction

atleast 180 degree of the circumference of the angle of anterior chamber were selected for combined procedures.

Subsequently the patients were kept in the hospital for a period of atleast 3 days. All intra-operative and post-operative complications were noted. Topical medication comprising of a combination of chloremphenicol and dexamethasone eye drops was applied 6 times a day for a period of 6 weeks. A short acting cycloplegic was used if and when necessary, the main objective being prevention of posterior synechiae formation. Systemic antibiotics and steroids were given.

During follow up at 6 weeks, refraction was performed and post-operative intraocular pressure recorded. A good intraocular pressure, control was defined as final post-operative intraocular pressure less than 21 mmHg, without anti glaucoma medication. A total ophthalmoscopic examination including direct ophthalmoscopy was done at 6 weeks.

Following statistical analysis was made :

1. To see whether any association with sex of patient existed.

2. To see whether the final visual acuity had any association with the type of glaucoma, duration of attack, pre-operative IOP levels and the type of surgery performed.
3. To see whether the post-operative intraocular pressure had any association with the modality of surgery performed.

OBSERVATIONS

OBSERVATIONSINCIDENCE OF LENS INDUCED GLAUCOMA - TABLE NO. 1 :

58 cases of lens induced glaucoma were studied amongst 526 cases of cataract operated in M.L.B. Medical College, Jhansi between November, 1996 and December, 1997. Incidence of lens induced glaucoma was 11.02% amongst total cataract operated. Of these 26 cases (4.94%) were of phacomorphic glaucoma and 32 (6.08%) were of phacolytic glaucoma.

SEX DISTRIBUTION OF LENS INDUCED GLAUCOMA - TABLE NO. 2 :

Of the 58 cases of lens induced glaucoma, 22 (37.93%) were males and 36 (62.06%) were females.

AVERAGE TIME OF PRESENTATION - TABLE NO. 3 :

Most of the patients, 28 cases (48.27%) presented between 6 and 14 days. 20 cases presented after 14 days (34.48%), while only 10 patients (17.24%) presented early within 5 days.

AVERAGE INTRA OCULAR PRESSURE AT TIME OF PRESENTATION
(TABLE NO. 4) :

As the time of presentation increased, the average intraocular pressure also increased. Patients who presented within 5 days had average intraocular pressure of 34.9 mm of mercury, those presenting in 6 to 14 days had 36.17 mm of mercury pressure and those who presented after 14 days had 46.5 mm of mercury pressure.

PRE-OPERATIVE VISUAL ACUITY AT TIME OF PRESENTATION
(TABLE NO. 5) :

A significant association was found between the duration of attack and the pre-operative visual acuity. Of the 10 patients who presented within 5 days, 8 had accurate light projection (80%), while 2 patients had inaccurate light projection (20%). Of the 28 patients who presented between 6 and 14 days, 18 had accurate light projection (64.28%), while 10 had inaccurate light projection (35.71%). Of the 20 patients who came 14 days after the onset of pain, only 20% i.e. 4 patients had accurate light projection while 80% i.e. 16 patients had inaccurate light projection.

PRE-OPERATIVE VISUAL STATUS IN RELATION TO PRE-OPERATIVE
INTRA-OCULAR PRESSURE (TABLE NO. 6) :

A highly significant association was found between the visual status and the level of intra-ocular pressure pre-operatively. 21 patients with IOP levels below 35 mm of mercury had accurate light projection, while only 7 had inaccurate light projection. 30 patients had IOP more than 35 mm of mercury; of these only 9 had accurate light projection while 21 had inaccurate light projection.

SURGICAL INTERVENTIONS (TABLE NO. 7) :

Four types of procedures were carried out in 58 patients. Intracapsular cataract extraction in 12 patients, extra-capsular cataract extraction in 21 patients. Intracapsular cataract extraction with trabeculectomy was done in 12 patients, while extracapsular cataract extraction with trabeculectomy was done in 13 patients.

INTRA AND POST OPERATIVE COMPLICATIONS (TABLE NO. 8) :

No statistical association was found between the type of surgery and the intra or post-operative complications. Accidental posterior capsular rupture occurred in 4 cases of ECCE and in 2 cases of ECCE with trabeculectomy. Vitreous loss occurred in 2 cases each of ICCE and ICCE with trabeculectomy, 3 cases of ECCE and 1 case of ECCE with trabeculectomy.

Post operatively striate keratitis corneal edema and uveitis were the most common complications. Shallow anterior chamber was seen in 1 case each of ICCE and ECCE. Hyphaema was seen in 3 cases each of ICCE and ICCE with trabeculectomy and in 5 cases of ECCE and 1 case of ECCE with trabeculectomy.

POST-OPERATIVE VISUAL ACUITY AND TYPE OF GLAUCOMA (TABLE NO. 9) :

No statistical association between type of glaucoma and final visual acuity was found. 8 patients in our study (13.79%) attained a good visual acuity of more than 6/12. 3 patients (11.53%) of phacomorphic glaucoma and 5 patients (15.62%) of phacolytic glaucoma attained a good visual acuity of more than 6/12. 14 cases each of phacomorphic

and phacolytic glaucoma attained final visual acuity between 6/18 and 6/60. 9 patients (34.6%) of phacomorphic glaucoma and 13 patients (40.6%) of phacolytic glaucoma attained visual acuity of less than 6/60.

VISUAL RECOVERY AGAINST DURATION OF ATTACK (TABLE NO. 10):

60% of the patients who presented within 5 days attained good visual acuity of more than 6/12, while only 7% of those who presented between 6 and 14 days could attain this visual acuity, 70% of those who presented after 14 days attained visual acuity of less than 6/60. Thus a highly significant association was found between the duration of attack and the visual outcome.

VISUAL RECOVERY AGAINST PREOPERATIVE TENSION (TABLE NO.11):

10.71% of patients with preoperative IOP less than 35 mm of mercury had final visual acuity more than 6/12, while 16.66% of those with IOP more than 35 mm of mercury preoperatively had final visual acuity more than 6/12. 53.57% of those with preoperative IOP less than 35 mm of mercury attained postoperative visual acuity between 6/18 and 6/60. 43.33% of those with preoperative IOP more than 35 mm of Hg attained this visual acuity. No statistical

association was found between the postoperative visual outcome and preoperative tension.

POSTOPERATIVE VISUAL ACUITY AGAINST THE TYPE OF OPERATION (TABLE NO. 12) :

Almost similar proportion of patients of the different modalities of surgery attained good post operative visual acuity of more then 6/12. No significance was found between the type of surgery and the final visual outcome.

POSTOPERATIVE VISUAL RECOVERY IN PATIENTS OF INACCURATE LIGHT PROJECTION PREOPERATIVELY (TABLE NO. 13) :

Of the 2 patients with inaccurate light projection who presented within 5 days, 1 attained visual acuity of 6/18 to 6/60 and 1 attained visual acuity less than 6/60. 60% of the patients of inaccurate light projection who presented between 6 and 14 days could attain finger counting vision. 13 patients of the 16 who presented after 14 days could attain no better than hand movements or perception of light. However, 3 of those who came after 14 days with inaccurate light projection could attain vision between 6/18 and 6/60. No statistical significance was found.

TABLE NO. 1

INCIDENCE OF LENS INDUCED GLAUCOMA

Total no. of cataract operated	Lens Induced Glaucoma	Phacomorphic Glaucoma	Phacolytic Glaucoma
526	58 (11.02%)	26 (4.94%)	32 (6.08%)

TABLE NO. 2

SEX DISTRIBUTION OF LENS INDUCED GLAUCOMA

Lens Induced Glaucoma	Male	Female
58	22 (37.93%)	36 (62.06%)

TABLE NO. 3

AVERAGE TIME OF PRESENTATION

Average Time of Presentation	No. of patients
< 5 days	10 (17.24%)
6 - 14 days	28 (48.27%)
≥ 14 days	20 (34.48%)

TABLE NO. 4LEVEL OF AVERAGE IOP AGAINST THE AVERAGE TIME
SINCE PRESENTATION

Average Time of Presentation	Average Pre-operative Intra-ocular Pressure
< 5 days	34.9 mmHg
6 - 14 days	36.17 mmHg
≥ 14 days	46.5 mmHg

TABLE NO. 5

RELATIONSHIP OF PRE-OPERATIVE VISUAL ACUITY
WITH TIME SINCE PRESENTATION.

Average Time of Presentation	PRE-OPERATIVE VISUAL ACUITY	
	Accurate Light Projection	Inaccurate Light Projection
< 5 days	8 (80%)	2 (20%)
6 - 14 days	18 (64.28%)	10 (35.71%)
> 14 days	4 (20%)	16 (80%)

= (P/<.05) Significant association.

TABLE NO. 6

PRE-OPERATIVE VISUAL STATUS AGAINST THE
PRE-OPERATIVE I.O.P.

Pre-operative visual status	\angle 35 mmHg (c)	∇ 35 mmHg (d)
Eyes with Accurate Light Projection (a)	21 (75%)	9 (30%)
Eyes with Inaccurate Light Projection (b)	7 (25%)	21 (70%)

Significant association.

TABLE NO. 7

DISTRIBUTION AND TYPE OF SURGICAL PROCEDURE DONE

Type of Operation	No. of Patients
1. Intracapsular cataract extraction	12
2. Intracapsular Cataract Extraction with Trabeculectomy	12
3. Extracapsul Cataract Extraction	21
4. Extracapsular Cataract Extraction with Trabeculectomy	13

TABLE NO. 8TYPE OF SURGERY, OPERATIVE AND POST OPERATIVE COMPLICATIONS

COMPLICATIONS	ICCE	ICCE with Trabecul- ectomy	ECCE	ECCE with Trabecul- ectomy
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INTRA-OPERATIVE

1. Posterior Capsule Rupture	-	-	4 (19%)	2 (15.38%)
2. Vitreous loss	2 (16.6%)	2 (16.6%)	3 (14.28%)	1 (7.69%)

POST-OPERATIVE

1. Striate Keratopathy	4 (33%)	1 (8.3%)	5 (23.8%)	3 (23.08%)
2. Corneal Edema	2 (16.6%)	1 (8%)	6 (28%)	2 (15.38%)
3. Shallow Anterior Chamber	1 (8.3%)	-	1 (4.76%)	-
4. Severe Iritis	-	3 (20%)	4 (19%)	4 (30.77%)
5. Hyphaema	3 (25%)	3 (25%)	5 (23.8%)	1 (7.69%)

TABLE NO. 9

VISUAL RECOVERY AGAINST TYPE OF GLAUCOMA

Post Operative visual acuity	Phacomorphic Glaucoma	Phacolytic Glaucoma
6/6 - 6/12	3 (11.53%)	5 (15.62%)
6/18 - 6/60	14 (53.84%)	14 (43.75%)
≤ 6/60	9 (34.6%)	13 (40.6%)

(No association between type of glaucoma
and recovery)

TABLE NO. 10VISUAL RECOVERY AGAINST DURATION OF ATTACK

Duration of Attack	6/6 - 6/12 (Post-Op.)	6/18 - 6/60 (Post-Op.)	6/60 (Post-Op.)
< 5 days	6 (60%)	3 (30%)	1 (10%)
6 - 14 days	2 (7%)	19 (67.85%)	7 (25%)
> 14 days	-	6 (30%)	14 (70%)

(P < .001) Significant association

TABLE NO. 11VISUAL RECOVERY AGAINST PRE-OPERATIVE TENSION

Post-Operative Visual Acuity	\angle 35 mmHg (Pre-Operative Tension	$\overline{7}$ 35 mmHg (Pre-Operative Tension
6/6 - 6/12	3 (10.71%)	5 (16.66%)
6/18 - 6/60	15 (53.57%)	13 (43.33%)
\angle 6/60	10 (35.71%)	12 (40%)

Not significant

TABLE NO. 12

VISUAL RECOVERY AGAINST THE TYPE OF OPERATION

Post Operative Visual Acuity	ICCE	ICCE with Trabecul- ectomy	ECCE	ECCE with Trabecul- ectomy
6/6 - 6/12	1 (3.33%)	2 (16.67%)	3 (14.28%)	2 (15.38%)
6/18 - 6/60	5 (41.67%)	4 (33.33%)	15 (71.43%)	4 (30.77%)
≤ 6/60	6 (50%)	6 (50%)	3 (41.28%)	7 (53.85%)

Not significant

TABLE NO. 13

VISUAL RECOVERY IN PATIENTS WITH INACCURATE LIGHT
PROJECTION PRE-OPERATIVELY

Duration of Attack	No. of patients with inaccurate PL	6/6-6/12	6/18-6/60	\angle 6/60
\angle 5 days	02	-	1	1
6 - 14 days	10	1	3	6
$\overline{7}$ 14 days	16	-	3	13

Not significant

TABLE NO. 14

POST OPERATIVE IOP AGAINST THE MODALITY OF SURGERY

Duration of Attack	ICCE Group		ICCE + Trabeculectomy		ECCE Group		ECCE + Trabeculectomy	
	Avg. Pre-op Tension (mmHg)	Avg. Post-op Tension (mmHg)	Avg. Pre-op Tension (mmHg)	Avg. Post-op Tension (mmHg)	Avg. Pre-op. Tension (mmHg)	Avg. Post-op. Tension (mmHg)	Avg. Pre-op. Tension (mmHg)	Avg. Post-op. Tension (mmHg)
< 5 days	30.93 (3 cases)	16.0	31.9 (2 cases)	14.3	36.9 (3 cases)	17.0	40.85 (2 cases)	16.6
6 - 14 days	36.28 (5 cases)	18.0	30.06 (5 cases)	16.0	37.3 (12 cases)	19.5	39.36 (6 cases)	18.0
> 14 days	42.55 (4 cases)	25.75	54.44 (5 cases)	19.5	44.85 (6 cases)	24.4	42.88 (5 cases)	23.0

DISCUSSION

DISCUSSION

Lens induced glaucomas are a common occurrence in India, hardly surprising in a situation where the incidence of cataract cases far exceeds the total number of surgeries performed currently. Though phacomorphic and phacolytic glaucomas are clinically distinct entities they have certain common factors in that they are lens induced, they compromise the function of the optic nerve due to rise of intraocular pressure, cataract surgery is curative in these cases and finally they uniformly share a guarded prognosis.

This study was undertaken to determine the post-operative visual results and to evaluate any risk factors, which may play a role in the determination of final post-operative visual acuity.

From November, 1996 to December, 1997 a total of 526 senile cataracts were operated at M.L.B. Medical College, Jhansi, including 58 cases of lens induced glaucoma (incidence 11.02% of all cases of cataract operated). Of these 26 cases were of phacomorphic glaucoma (4.94% of all cataract operated) while 32 were of phacolytic glaucoma (6.08% of all cataract operated).

Table No. 1.

Angra et al (1991)³⁷ reported an incidence of 3.91% for phacomorphic glaucoma. Jain et al (1983)⁴ also reported an incidence of 3.91% of phacomorphic glaucoma. Our study being conducted in a relatively backward area of Bundelkhand reported a slightly higher incidence. This could probably be due to the lack of medical amenities and the common belief among people that a cataract is not fit to be operated upon until ripe. Cataract in Indians, also tends to become intumescent more commonly than in Europeans.

In our study, females seem at a higher risk of developing lens induced glaucoma (Table No. 2). It could be because of the lesser attention recieved by old women in rural India and secondly because females also have a shallower anterior chamber depth, thus making them more prone for angle closure. We also have to consider the fact that the prevalence of cataract itself is more common in females than in males. This finding was consistant with data from studies by Chatterjee et al (1982)⁵⁹, Framingham eye study (1977)⁶⁰, Pranja et al (1996)⁵⁷, Jain et al (1983)⁴, Angra et al (1991)³⁷.

Majority of the patients reported between 1 - 2 weeks time since the onset of pain (Table No. 3). This is due to the largely rural catchment area where both lack of medical facilities and lack of awareness prevails.

The intraocular pressure of 58 patients varied between 26.6 and 69.3 mm of mercury. The average pre-operative intraocular pressure of those who presented within 5 days was 34.9 mm of mercury who presented within 6-14 days was 36.17 mm of mercury while those who presented after 14 days it was 46.5 mm of mercury (Table No. 4). Thus pre-operative intraocular pressure showed a progressive rise as the duration of attack increased. Jain et al (1983)⁴ and Prajna et al (1996)⁵⁷ reported similar findings. But Angra et al (1991)³⁷ found no relationship between duration of attack and the height of intraocular pressure.

Only 20% of patients who presented within 5 days had inaccurate light projection while 80% of those who presented later than 14 days had inaccurate light projection (Table No. 5). A highly significant association ($P < .05$) was found between the time elapsed since onset of pain and medical intervention and the pre-operative visual status. Jain et al (1983)⁴, Angra et al (1991)³⁷ and Singh et al (1994)¹¹ obtained similar findings. Angra et al (1991)³⁷ say

that this could probably be because of the sudden high intraocular pressure which caused optic nerve ischemia leading to conduction defects.

Of the 30 patients who had an accurate light projection, 75% also had preoperative intraocular pressure less than 35 mm of mercury, (Table No. 6), while 70% of the 28 patients with inaccurate light projection had intraocular tension more than 35 mm of mercury. A highly significant association was found between the preoperative intraocular tension and the preoperative visual status. Jain et al (1983)⁴ reported similar findings.

Medical management constitutes an important step in the care of lens induced glaucoma. We found that in our series intraocular pressure in 46.55% patients (i.e. 27 cases) could not be controlled medically. These eyes were found to have extensive peripheral anterior synechiae and a longer duration of attack. Varma et al (1980) and Jain et al (1983)⁴ were able to obtain control of intraocular pressure in 100% cases. Angra et al (1991)³⁷ could not control intraocular pressure in 37.5% cases, while Prajna et al (1996)⁶⁷ could not control intraocular pressure medically in 40% cases.

Visual status could also be improved after medical management in the sense that out of the 28 cases who presented with faulty light projection, 8 could be made to have accurate light projection by bringing down the intraocular pressure.

In our series, (Table No. 7) -

12 patients underwent intra-capsular cataract extraction

12 patients intracapsular cataract extraction with trabeculectomy.

21 patients extracapsular cataract extraction

13 patients extracapsular cataract extraction with trabeculectomy.

Trabeculectomy with cataract extraction was usually performed in those cases in which peripheral anterior synechiae extended for 180 degree or more gonioscopically.

Intra operative complications of posterior capsular rupture and vitreous loss although slightly more in the extracapsular cataract extraction group, are not statistically significant (Table No. 8). Post operative corneal edema and striate keratitis occurred more often in cases of cataract extraction alone than in combined extraction group. One of the reasons may be that in the combined procedure, the section is more scleral and hence larger, with a minimal chance of the lens, swollen or otherwise

rubbing against the back of the cornea. The better control of intraocular pressure in those with combined procedure may be another factor. Post-operative shallow anterior chamber was found in the cataract extraction alone group because of better control of intraocular pressure in the combined extraction group. Jain et al (1983)⁴ found more complications in the cases of combined extraction. Angra et al (1991)³⁷ also compared these surgical modalities in lens induced glaucoma and did not find any statistically significant difference in the rate of complications amongst these groups.

Historically there has been almost unanimous agreement that intracapsular cataract extraction should be done in these cases and more so in cases of phacolytic glaucoma because the posterior lens capsule is fragile and has microscopic defects.

This in turn can lead to a phacoanaphylatic reaction postoperatively (Zeeman 1943)¹⁶. Extracapsular surgery was first advocated by Irvine in 1957.³³ He believed that this technique helps in the prevention of the forward movement of the vitreous and hence vitreous loss. Gross and Pearce (1984)³⁴ used current microscopic extracapsular technique and reported excellent results in their cases of phacolytic

glaucoma. Lane et al¹⁰ also reported similar results in 1988. All their 5 cases of phacolytic glaucoma, who were treated by extracapsular cataract extraction with posterior chamber intraocular lens implantation, had controlled intraocular pressure with excellent visual results. Similar results were obtained by Jain et al (1983)⁴, Singh et al (1994)¹¹, Pranja et al (1996)⁵⁷. Mandal A.K. (1996)¹² advocates aspiration of fluid cortex from the capsular bag before performing anterior capsulotomy and then capsular bag fixation of intraocular lenses in phacolytic glaucoma. The surgical treatment of lens induced glaucoma has thus come a long way from intracapsular cataract extraction to standard extracapsular cataract extraction and now endocapsular surgery with capsular bag fixation of intraocular lenses.

In our study too we found comparable rates of complications for both the procedures. We did not find a higher incidence of weak capsular or zonular support.

Table 9 shows no statistical association between the type of glaucoma and the postoperative visual recovery. Angra et al (1991)³⁷ and Prajna et al (1996)⁵⁷ reported similar findings. We found 11.53% patients of phacomorphic glaucoma and 15.62% patients of phacolytic glaucoma

recovered good visual acuity of more than 6/12 post-operatively. Prajna et al (1991)⁵⁷ obtained post-operative visual acuity of more than 6/12 in 57% cases of phacomorphic glaucomas and in 61% cases of phacolytic glaucoma. 9 patients of phacomorphic glaucoma and 13 patients of phacolytic glaucoma had visual acuity less than 6/60. In all the 9 patients of phacomorphic glaucoma and 6 patients of phacolytic glaucoma, it was due to compromised optic nerves due to the glaucomatous process itself (disc showed pallor, cupping or atrophy) while 5 patients had severe persistent post operative uveitis and 2 patients had senile macular degeneration.

A highly significant association ($p < .001$) was found between the time elapsed since onset of pain and surgical intervention with the postoperative visual acuity. This explains the lesser percentage of patients with good recovery as most presented late.

Jain et al (1983)⁴ also reported that as the duration of attack increased there was a progressive decline in the recovery of visual acuity and beyond 3 weeks only light perception or hand movements could be recovered. Angra et al (1991)³⁷ also reported that the final visual prognosis was directly proportional to the duration of attack. Prajna et al (1996)⁵⁷ had similar findings.

Table No. 11 shows that the pre-operative tension has no bearing on the final visual outcome. Prajna et al (1991)³⁷ also obtained a similar result.

Table no. 12 shows no statistical correlation between final visual recovery and the type of operation. Angra et al (1991)³⁷ compared the results of intracapsular cataract extraction alone and combined procedure and found equally good results. Jain et al (1983)⁴, however, found poorer outcome with the addition of trabeculectomy to cataract extraction.

Table no. 13 shows that of the 12 patients who presented within 14 days and had inaccurate light projection, 1 case recovered 6/12 vision and 7 eyes recovered better than finger counting vision. However, of the 16 eyes which presented more than 14 days after the attack 13 could achieve only hand movements or perception of light. Thus a good functional recovery can be expected if a case presents early despite of an initial inaccurate light projection.

50 of the 58 eyes (86%) had normal intraocular pressure at the end of follow up period without any medication. Better control was achieved in the combined

extraction group. This control also had a definite relationship with organic changes in the angle of anterior chamber with a better improvement in the outflow facility and the duration of attack. Jain et al (1983)⁴ achieved normalisation in 93% cases, while Angra et al (1991)³⁷ in 75% cases.

SUMMARY AND CONCLUSIONS

SUMMARY & CONCLUSIONS

SUMMARY :

Evaluation of the surgical modalities in relation to control of intraocular pressure, complications and visual prognosis in cases of lens induced glaucoma was done.

Of the 526 cases of cataract undergoing surgery 58 cases were of lens induced glaucoma - incidence 11.02%. Of these 26 were of phacomorphic (4.94% incidence) and 32 were of phacolytic type (6.08% incidence). Female preponderance existed.

Preoperative rise of intraocular pressure, and accuracy of light projection were significantly related to duration of attack.

The combined procedure that is intra or extracapsular cataract extraction with trabeculectomy seemed superior in controlling intraocular pressure especially in eyes with longer duration of attack. Extracapsular cataract extraction was found to be a safe and efficacious method of visual rehabilitation in lens induced glaucoma. The final visual outcome was directly proportional to the duration of attack rather than to the type of cataract,

pre-operative intraocular tension and modality of surgery. A good functional recovery was obtained if the attack lasted less than 14 days beyond which only hand movements or light perception could be obtained.

CONCLUSIONS :

From this study we came to the following conclusions :

1. Pre-operative intraocular pressure was significantly related to duration of attack.
2. Pre-operative visual acuity was significantly related to duration of attack.
3. Final visual outcome was related to duration of attack.
4. The type of surgical procedure had no bearing on the final visual outcome.
5. Combined procedure was better in controlling post-operative intraocular pressure especially in those with more than 14 days of attack.
6. Extracapsular cataract extraction can be safely performed in lens induced glaucoma without additional risks of complications.

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